LHT65 Temperature & Humidity Sensor User Manual

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1. Introduction

1.1 What is LHT65 Temperature & Humidity Sensor

The Dragino LHT65 Temperature & Humidity sensor is a Long Range LoRaWAN Sensor. It includes a **built-in SHT20 Temperature & Humidity sensor** and has an external sensor connector to connect to external sensors such as **Temperature Sensor, Illumination sensor, Interrupt Sensor, ADC sensor etc** .

The LHT65 allows users to send data and reach extremely long ranges. It provides ultra-long range spread spectrum communication and high interference immunity whilst minimizing current consumption. It targets professional wireless sensor network applications such as irrigation systems, smart metering, smart cities, building automation, and so on.

LHT65 has a built-in 2400mAh non-chargeable battery which can be used for more than 10 years*.

LHT65 is full compatible with LoRaWAN v1.0.2 protocol, it can work with standard LoRaWAN gateway.

LHT65 has 3200 data records with datetime which can be retrieved with datetime for further analyze.

*The actually battery life depends how often to send data, please see battery analyzer chapter.

1.2 Features

- ✓ Wall mountable
- ✓ LoRaWAN Class A protocol
- ✓ Frequency Bands: CN470/EU433/KR920/US915/EU868/AS923/AU915
- ✓ AT Commands to change parameters
- ✓ Remote configure parameters via LoRaWAN Downlink
- ✓ Firmware upgradable via program port
- ✓ Built-in 2400mAh battery for more than 10 year use.
- ✓ Built-in Temperature & Humidity sensor
- ✓ Optional External Sensors
- ✓ Tri-color LED to indicate status
- ✓ 3200 set sensor record with time stamp

1.3 Specifications

Built-in Temperature Sensor:

- ➢ Resolution: 0.01 °C
- ➢ Accuracy Tolerance : Typ ±0.3 °C
- ➢ Long Term Drift: < 0.02 °C/yr
- ➢ Operating Range: -40 ~ 125 °C

Built-in Humidity Sensor:

- ➢ Resolution: 0.04 %RH
- ➢ Accuracy Tolerance : Typ ±3 %PH
- ➢ Long Term Drift: < 0.02 °C/yr
- ➢ Operating Range: 0 ~ 100 °C

External Temperature Sensor – E1:

- ➢ Resolution: 0.0625 °C
- ➢ ±0.5°C accuracy from -10°C to +85°C
- ➢ ±2°C accuracy from -55°C to +125°C
- ➢ Operating Range: -55 °C ~ 125 °C

External Illumination Sensor – E5:

- ➢ Resolution: 1 lx
- ➢ Range: 0-65535 lx
- ➢ Operating Range: -40 °C ~ 85 °C

1.4 Power Consumption

LHT65 (without external sensor): Idle: 3uA. Transmit: max 130mA.

LHT65 + E1 Temperature Sensor: Idle: 4uA, Transmit: max 130mA.

LHT65 + E5 Illumination Sensor: Idle: 4uA, Transmit: max 130mA.

1.5 Storage & Operation Temperature

-40°C to +85°C

1.6 Applications

- ✓ Smart Buildings & Home Automation
- ✓ Logistics and Supply Chain Management
- ✓ Smart Metering
- ✓ Smart Agriculture
- ✓ Smart Cities
- ✓ Smart Factory

2. Operation Mode

2.1 How to activate LHT65?

The LHT65 has two working modes:

- ✓ Deep Sleep Mode: LHT-65 doesn't have any LoRaWAN activate. This mode is used for storage and shipping to save battery life.
- ✓ Working Mode: In this mode, LHT65 will works as LoRaWAN Sensor mode to Join LoRaWAN network and send out the sensor data to server. Between each sampling/tx/rx periodically, LHT65 will be in STOP mode (IDLE mode), in STOP mode, device has the same power consumption as Deep Sleep mode.

The LHT65 is set in deep sleep mode by default; The ACT button on the bottom of device is used to switch to different modes:

Behavior on ACT	Function	Action
Pressing ACT between 1s < time < 3s	Test uplink status	If LHT65 is already Joined to LoRaWAN network, LHT65 will send an uplink packet, if LHT65 has external sensor connected, blue led will blink once. If LHT65 has not external sensor, red led will blink once.
Pressing ACT for more than 3s	Active Device	green led will fast blink 5 times, device will enter working mode and start to JOIN LoRaWAN network. green led will solid turn on for 5 seconds after joined in network.
Fast press ACT 5 times.	Deactivate Device	red led will solid on for 5 seconds. Means LHT65 are in Deep Sleep Mode.

2.2 How it works?

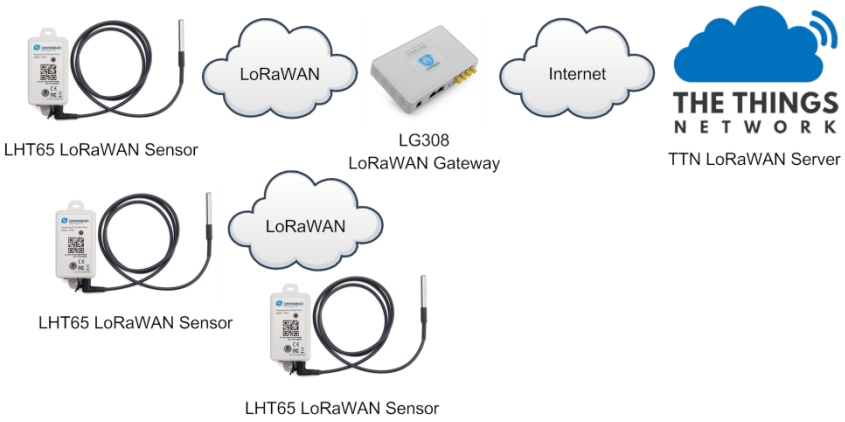
The LHT65 is configured as LoRaWAN OTAA Class A mode by default. Each LHT65 is shipped with a worldwide unique set of OTAA and ABP keys. To use LHT65 in a LoRaWAN network, user needs to input the OTAA or ABP keys in the network server. So LHT65 can join the LoRaWAN network and start to transmit sensor data. The default period for each uplink is 10 minutes.

In case user can't set the OTAA keys in the network server and has to use the existing keys from server. User can use AT Command to set the keys in LHT65.

2.3 Example to join LoRaWAN network

This section shows an example for how to join the TTN LoRaWAN IoT server. Use with other LoRaWAN IoT server is of similar procedure.

LHT65 in a LoRaWAN Network



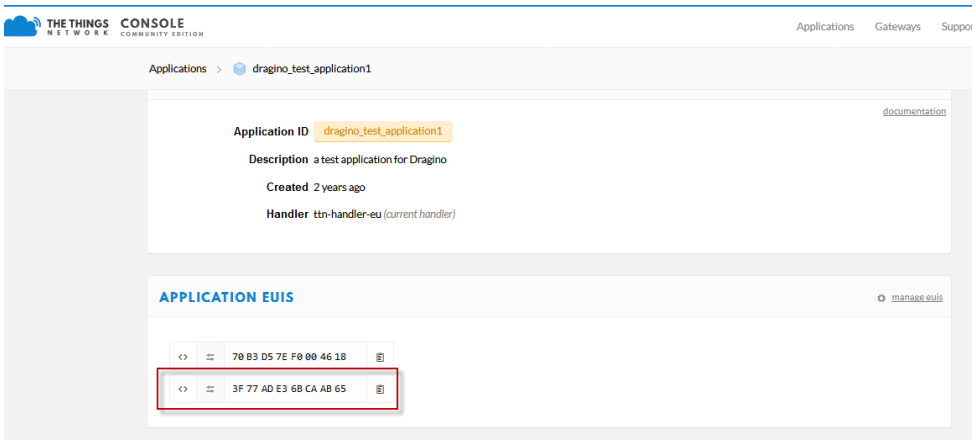
Assume the LG308 is already set to connect to TTN network . We need to add the LHT65 device in TTN:

Step 1: Create a device in TTN with the OTAA keys from LHT65.

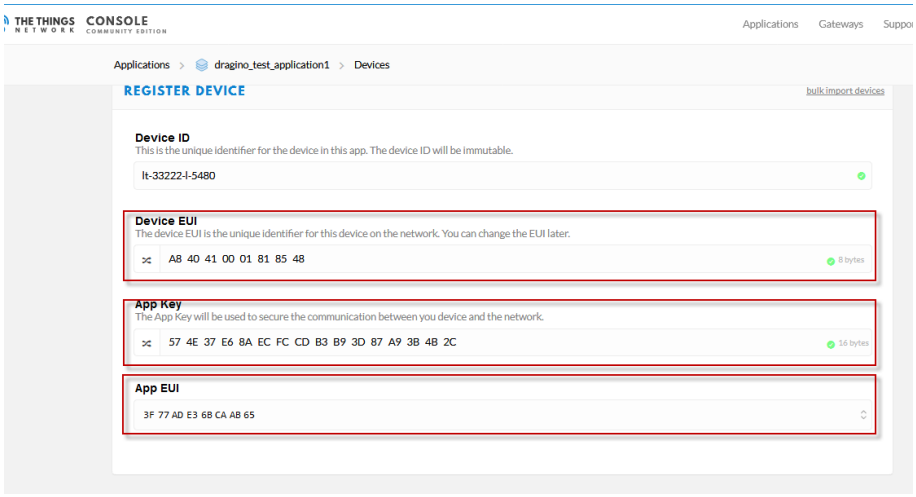
Each LHT65 is shipped with a sticker with the default device EUI as below:

User can enter these keys in the LoRaWAN Server portal. Below is TTN screen shot:

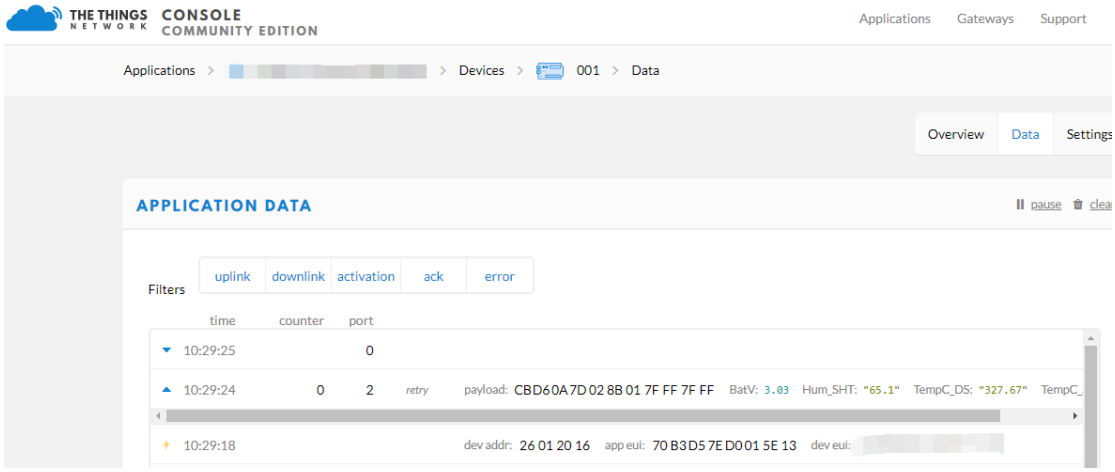
Add APP EUI in the application.



Add APP KEY and DEV EUI



Step 2: Use ACT button to activate LHT65 and it will auto join to the TTN network. After join success, it will start to upload sensor data to TTN and user can see in the panel.



2.4 Uplink Payload

The uplink payload includes totally 11 bytes. Uplink packets use FPORT=2 and every 10 minutes send one uplink by default.

After each uplink, the BLUE LED will blink once.

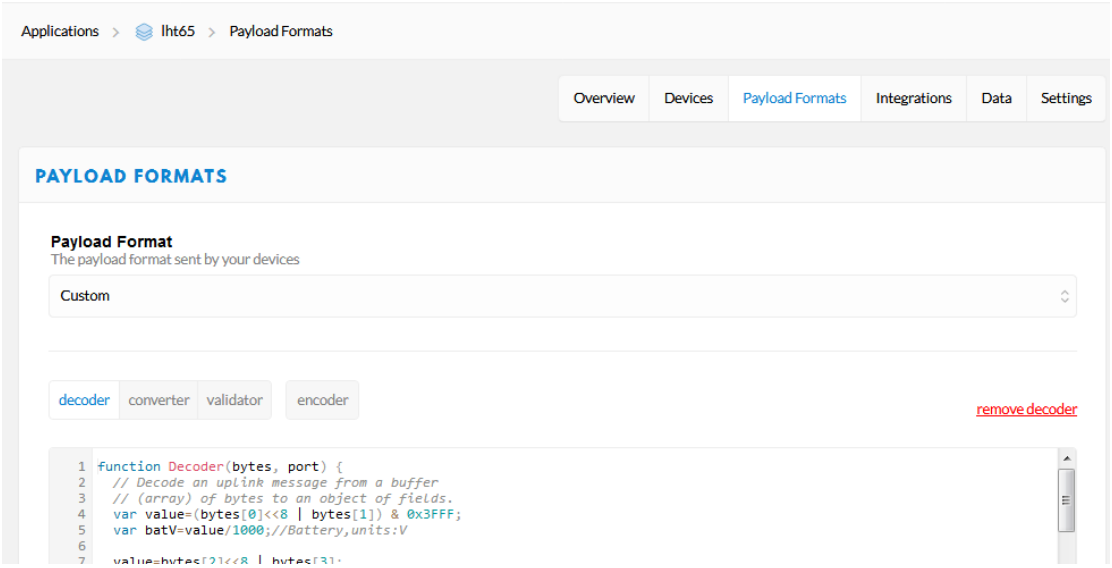
Size(bytes)	2	2	2	1	4
Value	BAT	Built-In Temperature	Built-in Humidity	Ext #	Ext value

First 6 bytes: has fix meanings for every device.

The 7th byte (EXT #): defines the external sensor model.

The 8th ~ 11th byte: the value for external sensor value. The definition is based on external sensor type. (If EXT=0, there won't be these four bytes.)

2.4.1 Decoder in TTN

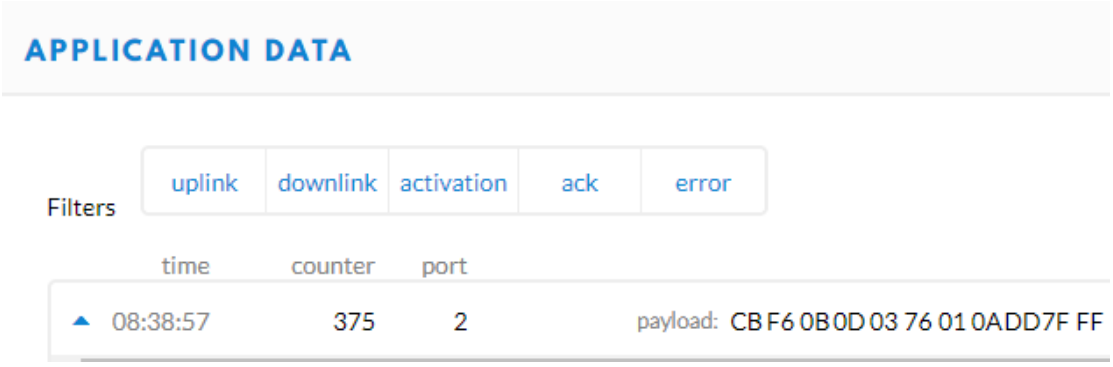


Please check the decoder from this link:
http://www.dragino.com/downloads/index.php?dir=LHT65/payload_decode/

2.4.2 BAT-Battery Info

These two bytes of BAT include the battery state and the actually voltage

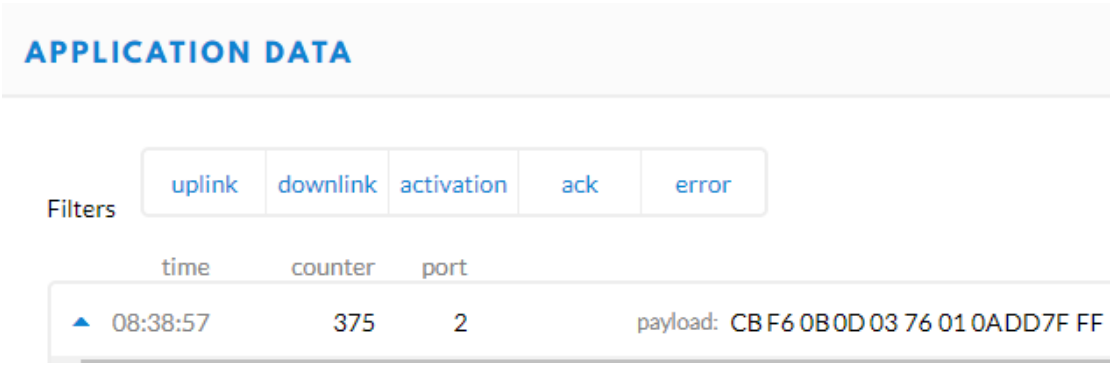
Bit(bit)	2	14
Value	BAT Status 00(b): Ultra Low (BAT <= 2.50v) 01(b): Low (2.50v <=BAT <= 2.55v) 10(b): OK (2.55v <= BAT <=2.65v) 11(b): Good (BAT >= 2.65v)	Actually BAT level



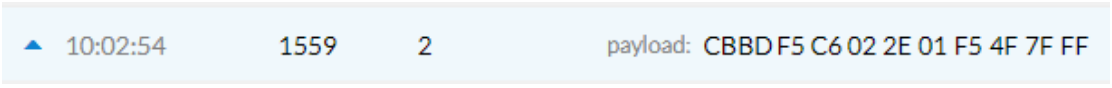
Check the battery voltage for LHT65.

- BAT status=(0xCBF6>>14)&0xFF=11(B)，very good
- Battery Voltage =0xCBF6&0x3FFF=0x0BF6=3062mV

2.4.3 Built-in Temperature

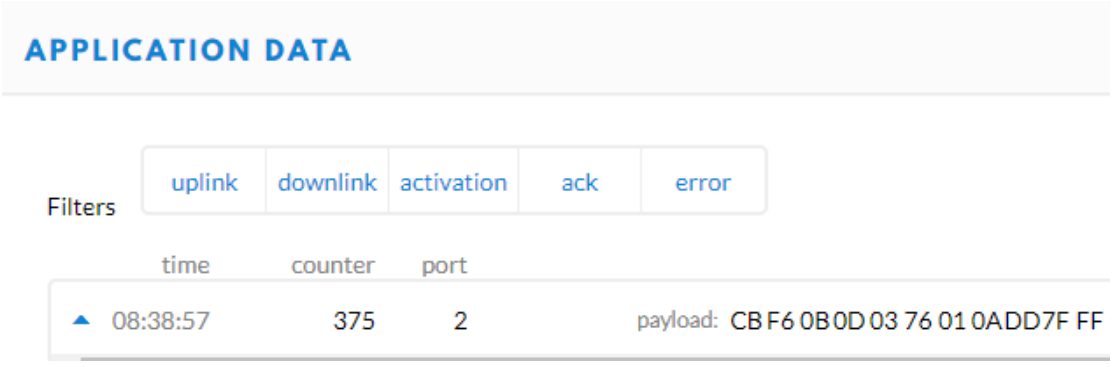


- Temperature: 0x0B0D/100=28.29℃



- Temperature: (0xF5C6-65536)/100=-26.18℃

2.4.4 Built-in Humidity



- Humidity: 0x0376/10=88.6%

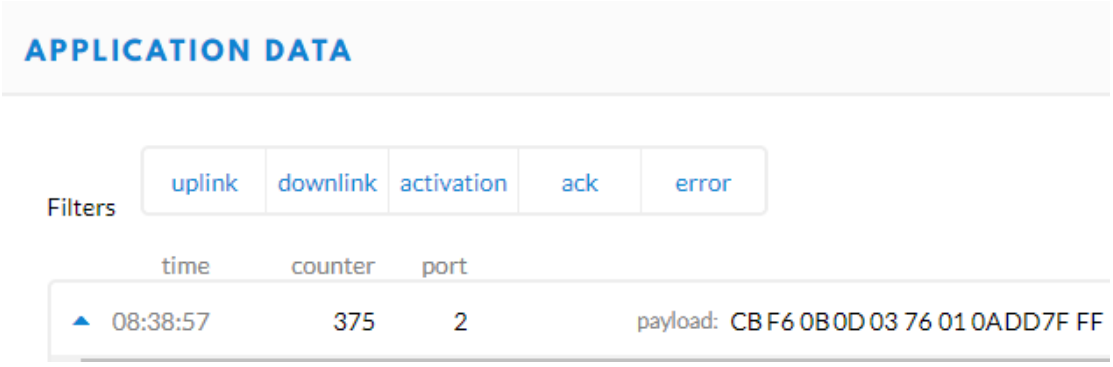
2.4.5 Ext

Bytes for External Sensor:

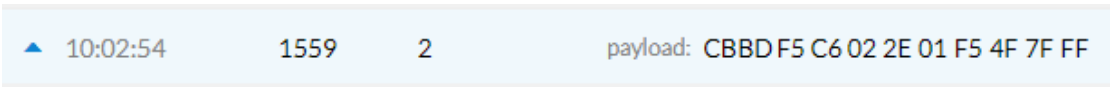
EXT # Value	External Sensor Type
0x01	Sensor E1, Temperature Sensor
0x04	Sensor E4, Interrupt Sensor
0x05	Sensor E5, Illumination Sensor
0x06	Sensor E6, ADC Sensor
0x07	Sensor E7, Counting Senor

2.4.6 Ext value

2.4.7 Ext=1, E1 Temperature Sensor



- DS18B20 temp=0x0ADD/100=27.81℃
  The last 2 bytes of data are meaningless



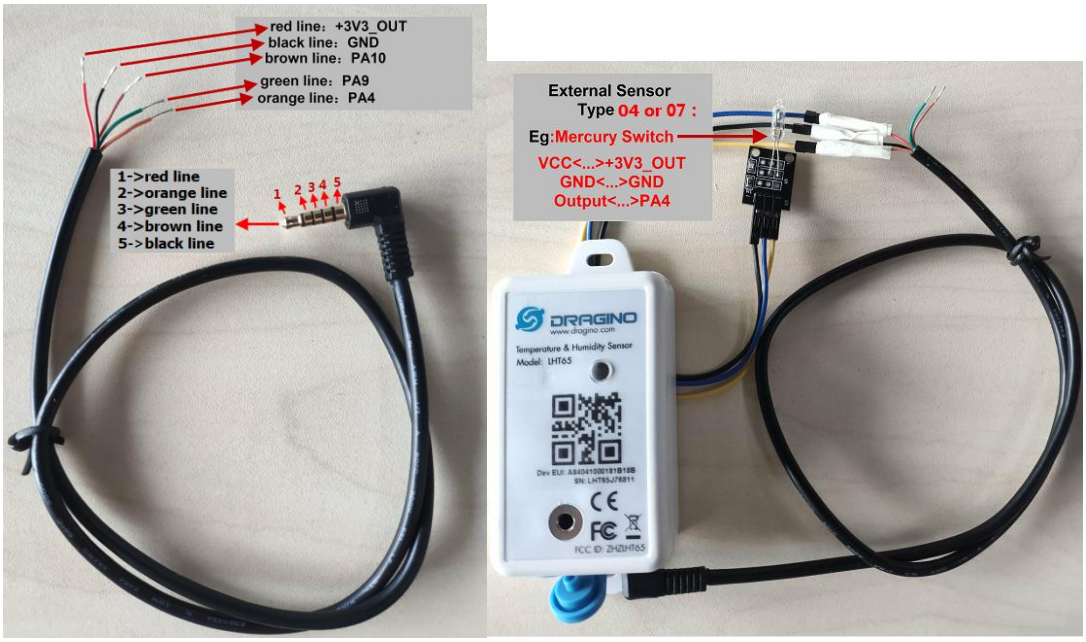
- DS18B20 temp= (0xF54F-65536)/100=-27.37℃
  The last 2 bytes of data are meaningless

If the external sensor is 0x01, and there is no DS18B20 connected. The temperature will be set to 7FFF which is 327.67℃

2.4.8 Ext=4, Interrupt Sensor

In this mode, user can connect external interrupt sensor to the **E2 Extension Cable** to check the open/close status from the sensor. For example, it can be used to connect to a door sensor to check the open / close status, or connect to a mercury switch to detect the titling.

(NOTE: This feature only supported by SN number > LHT65307029)



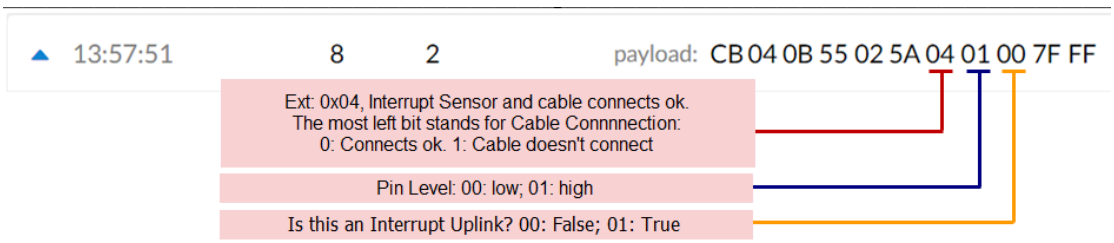
Above is connection to a mercury switch, rotate the mercury will generate interrupt. LHT65 will detect it and send an uplink package to sever. User can also connect PA9 and PA10 together, with these two pins shortcut, LHT65 will know if the probe is connected well in the socket.

User can use AT Command to set the method to detect Interrupt:

AT+EXT=4,1	Sent uplink packet in both rising and falling interrupt
AT+EXT=4,2	Sent uplink packet only in falling interrupt
AT+EXT=4,3	Sent uplink packet only in raising interrupt

Or use downlink command A2

Payload explain:



Means: The device is set to connect to an Interrupt Sensor, the cable connection is **fine**. This packet is for a **normal uplink**, pin level is **high**.

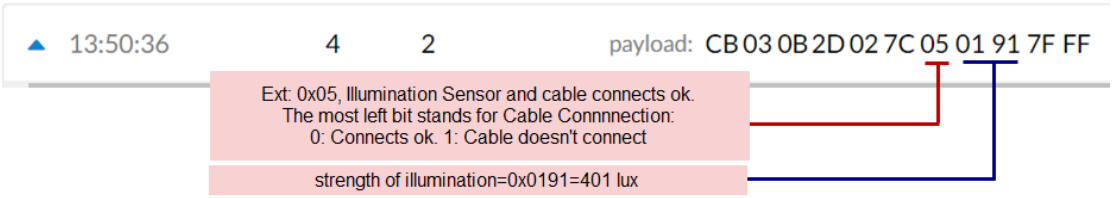
▲	13:59:38	10	2	payload: CB 06 0B 5B 02 77 04 00 01 7F FF

Means: The device is set to connect to an Interrupt Sensor, the cable connection is **fine**. This packet is for a Interrupt uplink, pin level is low.

▲	11:33:52	0	2	payload: CBDC0B 1C 02 E3 84 00 00 7F FF

Means: The device is set to connect to an Interrupt Sensor, the cable connection is **losing**. (Notice: PA9 and PA10 must be connected to detect if cable is losing or fine.).

2.4.9 Ext=5, E5 Illumination Sensor



Means: The device is set to connect to an Illumination sensor, the cable connection is **fine**.
This strength of illumination is 401 lux

Means: The device is set to connect to an Illumination sensor, the cable connection is **losing**.

2.4.10 Ext=6, ADC Sensor

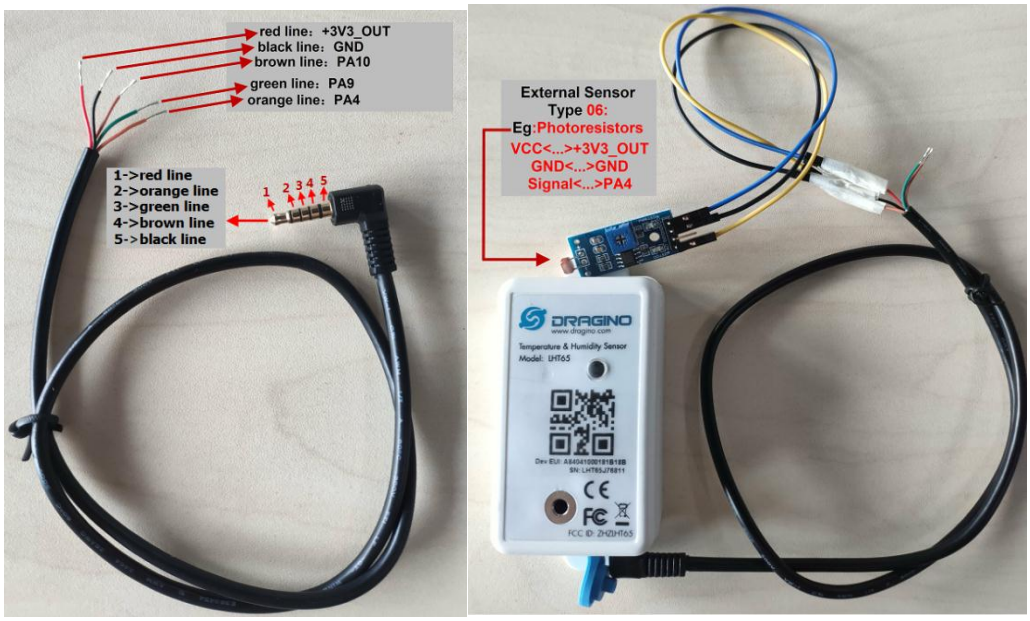
In this mode, user can connect external ADC sensor to check ADC value. The 3V3_OUT can be used to power the external ADC sensor; user can control the power on time for this sensor by setting:

AT+EXT=6,timeout Time to power this sensor, from 0 ~ 65535ms

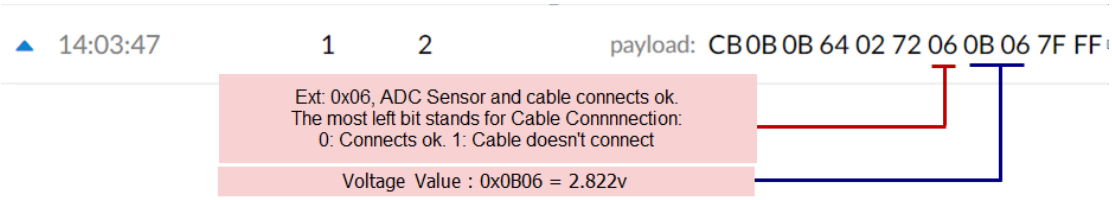
For example:

AT+EXT=6,1000 will power this sensor for 1000ms before sampling the ADC value.

Or use downlink command A2 to set the same.



User can also connect PA9 and PA10 together, with these two pins shortcut, LHT65 will know if the probe is connected well in the socket.



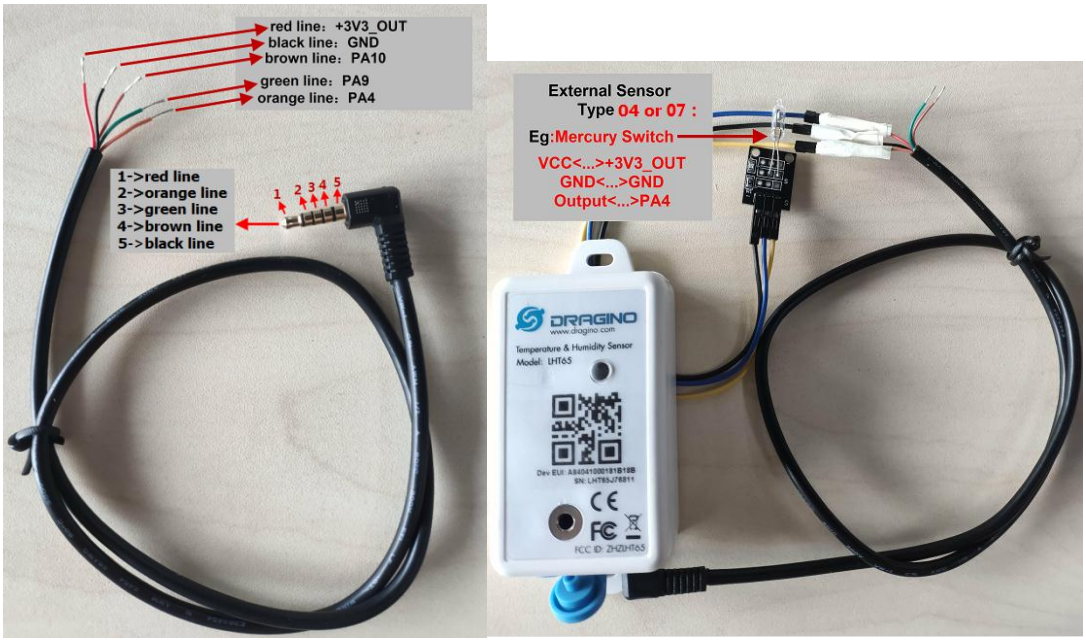
Means: The device is set to connect to an ADC sensor, the cable connection is **fine**. This voltage detected is 2.822v.

Means: The device is set to connect to an ADC Sensor, but the cable connection is **losing**. (Notice: PA9 and PA10 must be connected to detect if cable is losing or fine.).

2.4.11 Ext=7, Counting Sensor

In this mode, user can connect external interrupt sensor to the **E2 Extension Cable** for counting purpose. Whenever there is an interrupt from this sensor, the ext value will increase by 1.

(NOTE: This feature only supported by SN number > LHT65307029)



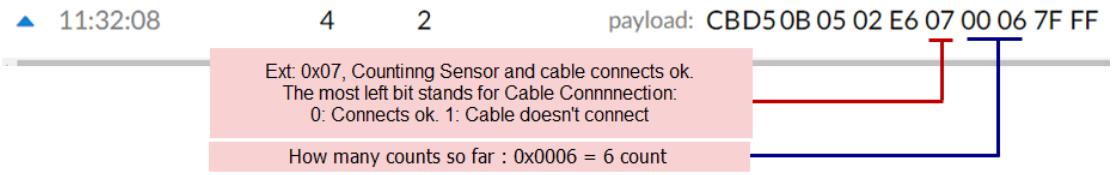
Above is connection to a mercury switch, rotate the mercury will generate interrupt. LHT65 will count it. It will periodically the counting value to server. User can also connect PA9 and PA10 together, with these two pins shortcut, LHT65 will know if the probe is connected well in the socket.

User can use AT Command to set the method to detect counting:

AT+EXT=7,0	Count at falling interrupt
AT+EXT=7,1	Count at raising interrupt
AT+SETCNT=60	Sent current count to 60

Or use downlink command A2

Payload explain:



Means: The device is set to connect to a counting sensor, the cable connection is **fine**. It detects 6 times event so far.

Means: The device is set to connect to a counting sensor, but the cable connection is **losing**.

Note: MAX count is FFFF, and then it will go back to 0001

2.5 Downlink Payload

After each success downlink, the PURPLE LED will blink once.

Downlink Command	FPort	Header	Downlink payload format
TDC (Transmit Time Interval)	Any	01	Total bytes: 4. Unit: Second Example: 0x01000258: Set AT+TDC=0x258=600S Recommend: higher than 0x12C (5 minuntes)
RESET	Any	04	Total bytes: 2 Example: 0x04FF, reset device
AT+CFM (Set Confirm status)	Any	05	Total bytes: 2 Example: 0x0501: AT+CFM=1, 0x0500: AT+CFM=0
AT+CHE	Any	07	Total bytes: 2 Example: 0x0702: AT+CHE=2
AT+DATE (Set time)	Any	A1	Total bytes: 7 Example: 0xA1190530162158: Set RTC time to 2019-5-30: 16:21:58
AT+EXT	Any	A2	Total bytes: 2 or 3 bytes Example: ✧ 0xA201: Set external sensor type to E1 ✧ 0xA20401: Same as AT+EXT=4,1 ✧ 0xA20603E8, Same as AT+EXT=6,1000 ✧ 0xA20700, Same as AT+EXT=7,0 ✧ 0xA20702003c,Same as AT+SETCNT=60
AT+CLRDTA (Clear Storage)	Any	A3	Total bytes: 2 Example: 0xA301: Clear data storage
AT+RTP (Set Record Time Period)	Any	A4	Total bytes: 3 unit: minutes Example: 0xA4000A: Set record time period to 10 minutes

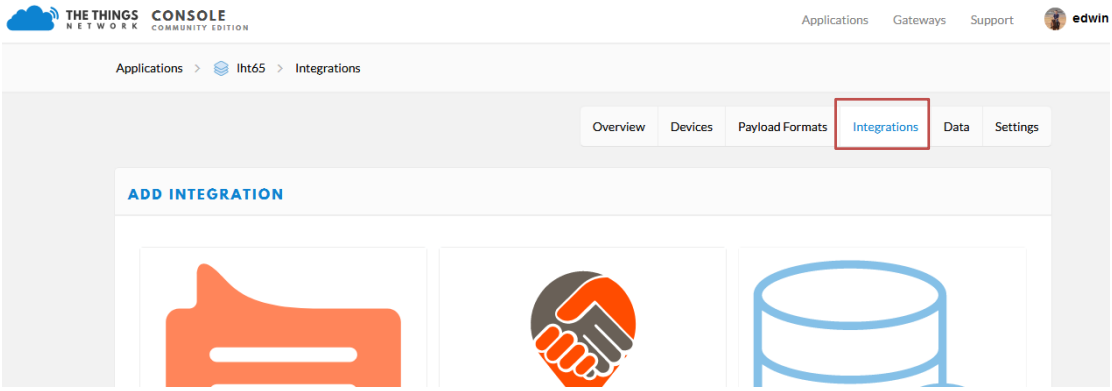
Example Downlink payload setting in TTN:

2.6 Show data on MyDevices

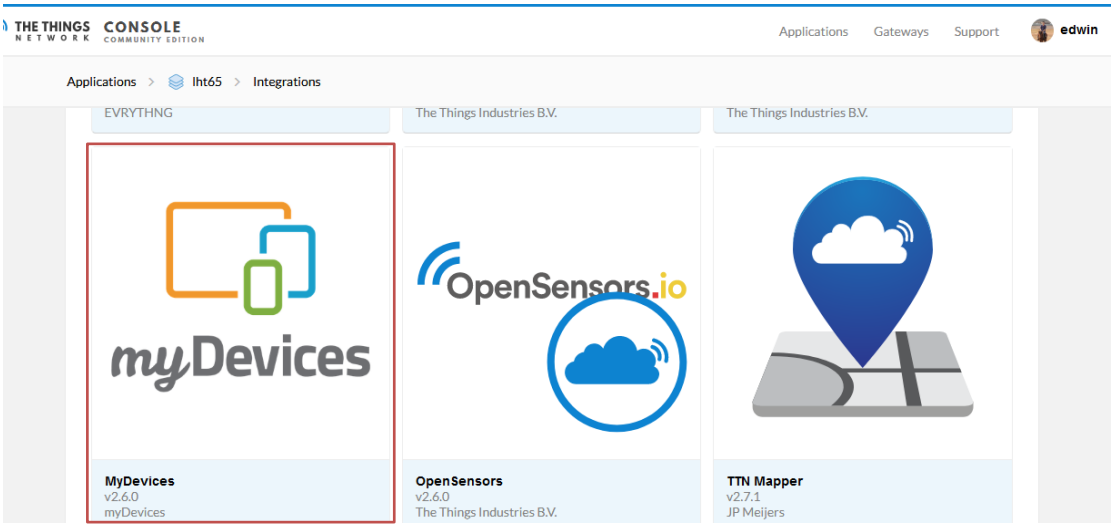
myDevices IoT platform provides a human friendly interface to show the sensor data, once we have sensor data in TTN, we can use myDevices to connect to TTN and see the data in myDevices. Below are the steps:

Step 1: Be sure that your device is programmed and properly connected to the LoRaWAN network.

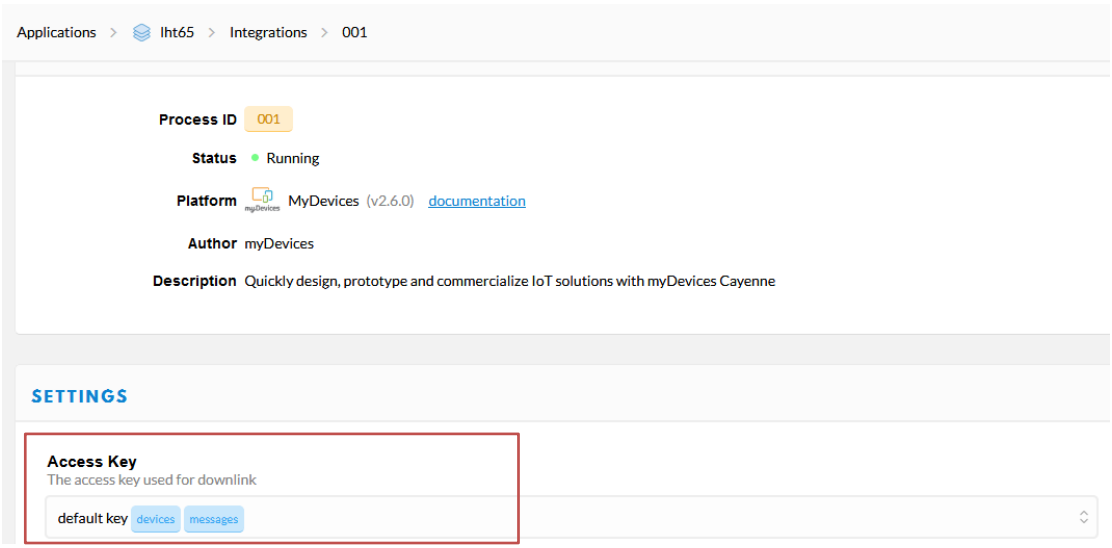
Step 2: Configure your Application to forward data to myDevices you will need to add integration. Go to TTN Console --> Applications --> Integrations --> Add Integrations.



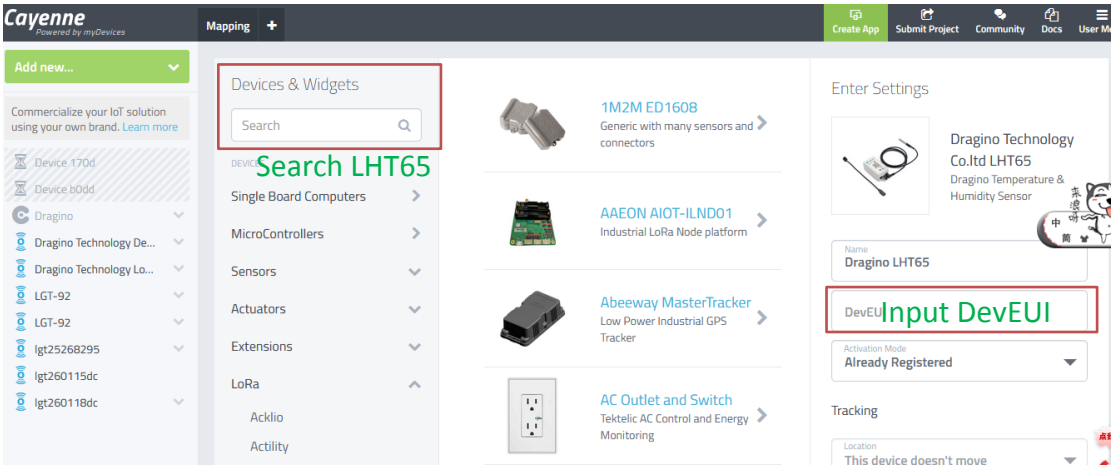
Add myDevices:

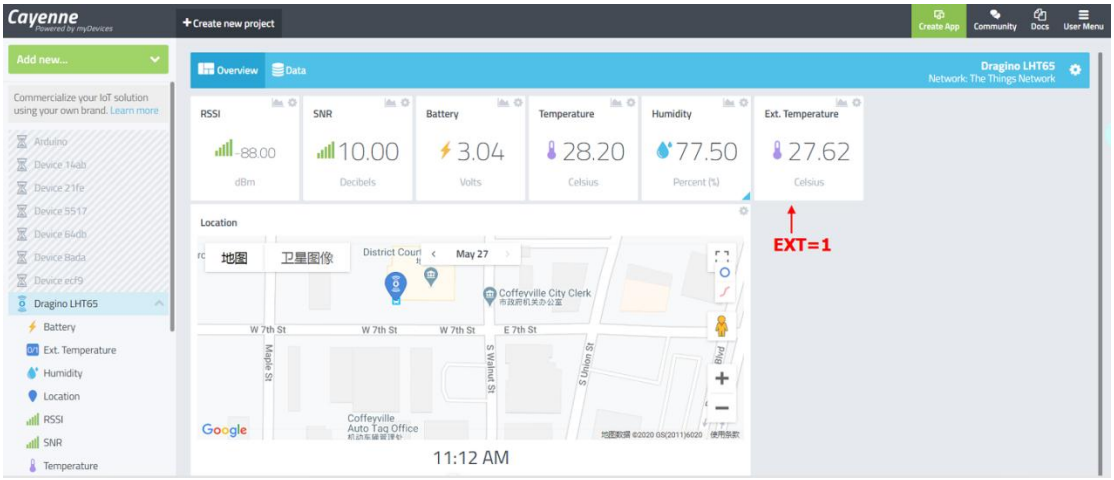


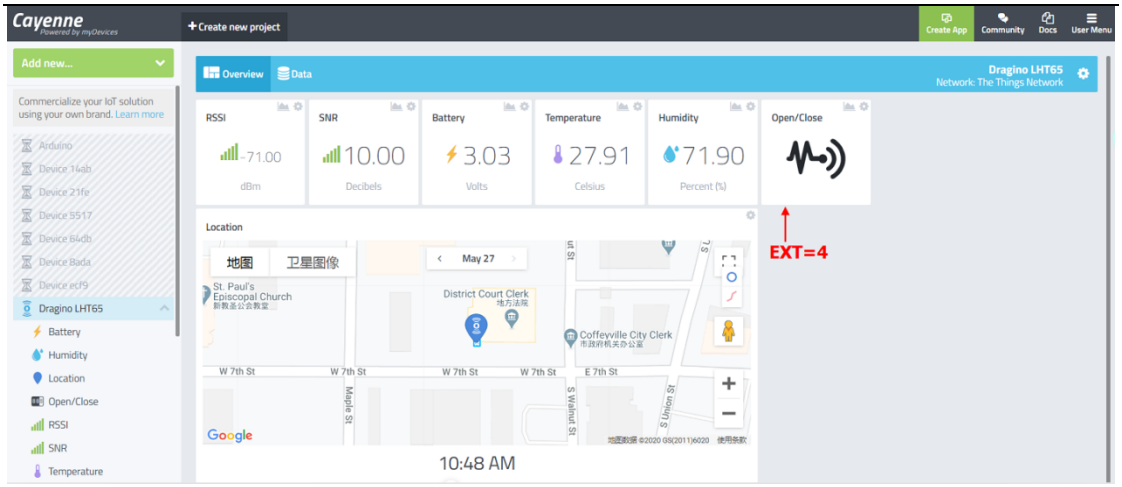
Select default key as Access Key:

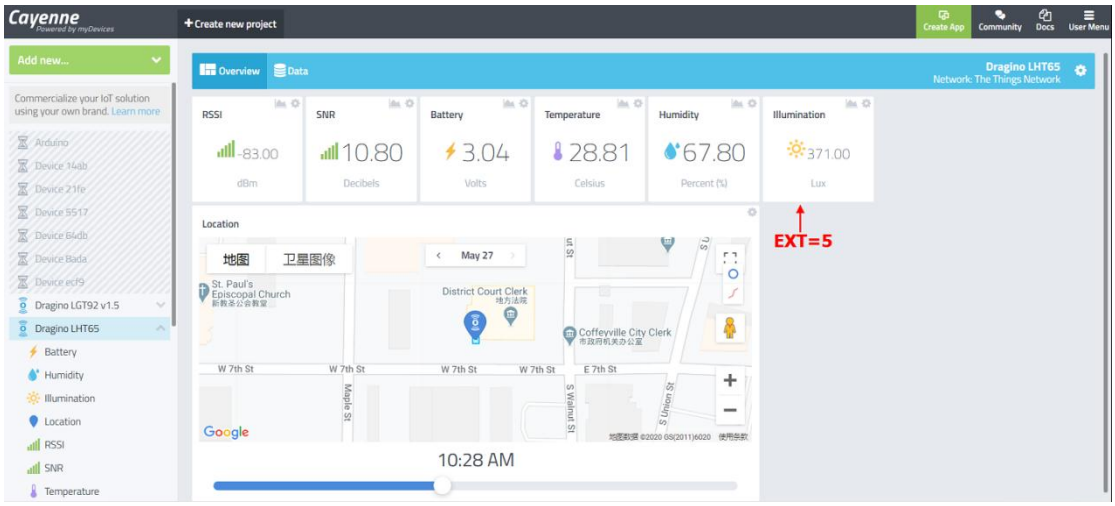


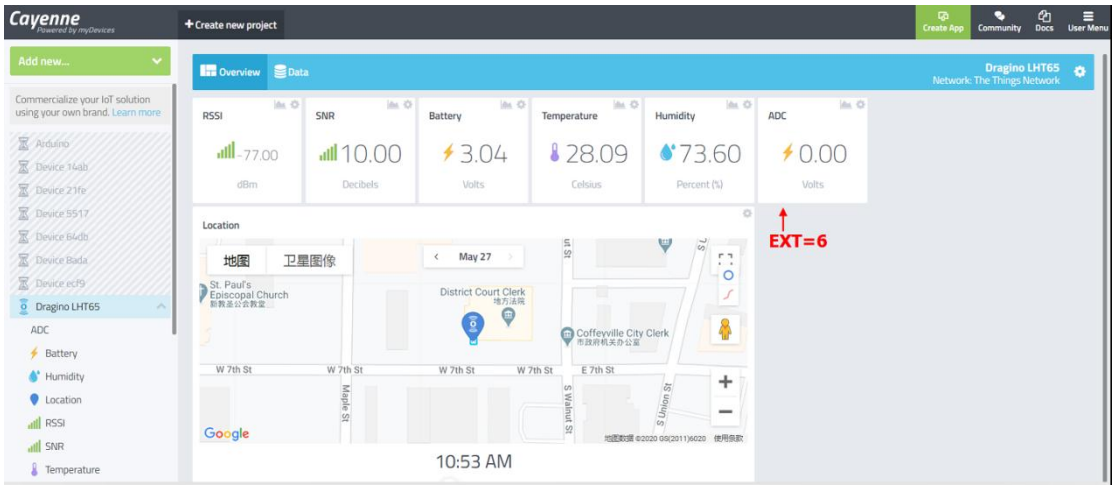
In myDevices console (https://cayenne.mydevices.com) , add LHT65:

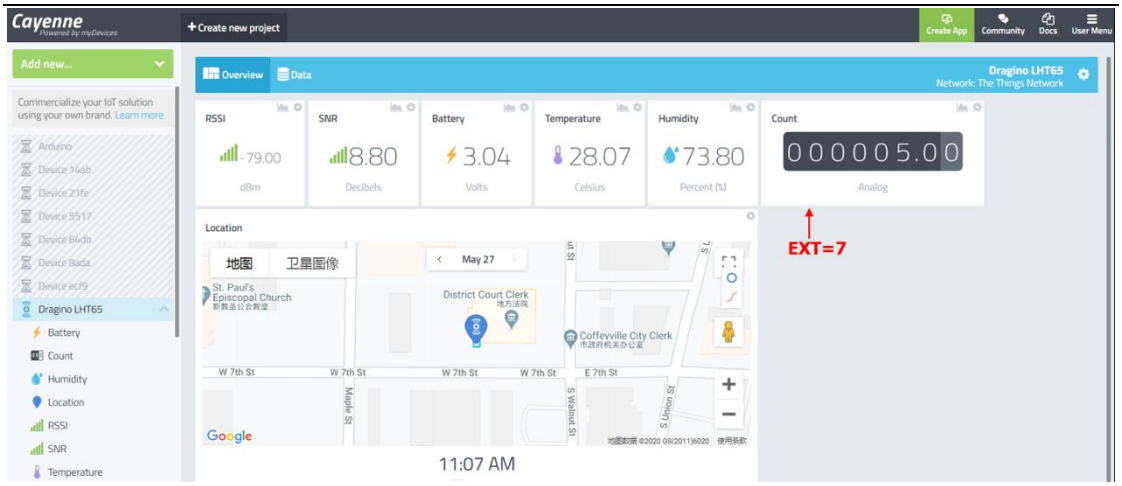





Cayenne
+Create new project
Create App
Community
Docs
User Menu
Add new...
Overview
Data
Dragino LHT65
Network: The Things Network
RSSI
-71.00
dBm
SNR
10.00
Decibels
Battery
3.03
Volts
Temperature
27.91
Celsius
Humidity
71.90
Percent (%)
Open/Close
EXT=4
Location
地图
卫星图像
May 27
St. Paul's Episcopal Church
District Court Clerk
Coffeyville City Clerk
Google
10:48 AM
Dragino LHT65
Battery
Humidity
Location
Open/Close
RSSI
SNR
Temperature


Cayenne
+Create new project
Create App
Community
Docs
User Menu
Add new...
Overview
Data
Dragino LHT65
Network: The Things Network
RSSI
-83.00
dBm
SNR
10.80
Decibels
Battery
3.04
Volts
Temperature
28.81
Celsius
Humidity
67.80
Percent (%)
Illumination
371.00
Lux
EXT=5
Location
地图
卫星图像
May 27
St. Paul's Episcopal Church
District Court Clerk
Coffeyville City Clerk
Google
10:28 AM
Dragino LGT92 v1.5
Dragino LHT65
Battery
Humidity
Illumination
Location
RSSI
SNR
Temperature


Cayenne
+Create new project
Create App
Community
Docs
User Menu
Add new...
Overview
Data
Dragino LHT65
Network: The Things Network
RSSI
-77.00
dBm
SNR
10.00
Decibels
Battery
3.04
Volts
Temperature
28.09
Celsius
Humidity
73.60
Percent (%)
ADC
0.00
Volts
EXT=6
Location
地图
卫星图像
May 27
St. Paul's Episcopal Church
District Court Clerk
Coffeyville City Clerk
Google
10:53 AM
Dragino LHT65
ADC
Battery
Humidity
Location
RSSI
SNR
Temperature



2.7 Read stored sensor data

LHT65 provides 3200 set local data storage feature, user can use AT Commands to retrieve these data for further analyze.

By default, LHT65 stores one set of data every 5 minutes. LHT65 has reversed 400 sectors for storage; each sector can store 8 sets data so total 3200 sets of data can be stored. LHT65 use circle storage method, means the storage position reach the 400th sector, it will go back and erase the 1st sector and store from this position.

Below are the AT Commands used to operate these data:

AT+PDTA=start,stop: Print the sector from start to stop.. Example:

AT+PDTA=1,1 will print the first sector (8 set of data)

```
Stop Tx and RTP events when read sensor data
8019500 19/6/3 16:47 1 2987 sht_temp=28.31 sht_hum=53.6 ds_temp=27.50
8019510 19/6/3 16:48 1 2989 sht_temp=28.38 sht_hum=54.0 ds_temp=27.50
8019520 19/6/3 16:49 1 2987 sht_temp=28.46 sht_hum=55.0 ds_temp=27.62
8019530
8019540
8019550
8019560
8019570
Start Tx and RTP events
OK
```

Explain of the format:

- ✓ 8019500 is the flash address.
- ✓ 19/6/3 16:47 is the time
- ✓ 1 after time means the external sensor type.
- ✓ 2987 : battery voltage
- ✓ sht_temp and sht_hum are the built in sensor temperature and humidity.

✓ ds_temp is the external sensor value.

AT+PLDTA: will print the most recent few sets of data. Example:

AT+PLDTA=10 will print the latest 10 sets data

```
Stop Tx and RTP events when read sensor data
1 19/6/25 10:39 1 3023 sht_temp=26.82 sht_hum=62.4 ds_temp=327.67
2 19/6/25 10:44 1 3025 sht_temp=26.77 sht_hum=62.7 ds_temp=327.67
3 19/6/25 10:51 1 3019 sht_temp=27.57 sht_hum=62.0 ds_temp=327.67
4 19/6/25 10:56 1 3019 sht_temp=27.90 sht_hum=60.1 ds_temp=327.67
5 19/6/25 11:01 1 3021 sht_temp=27.86 sht_hum=59.9 ds_temp=327.67

6 19/6/25 11:06 1 3019 sht_temp=28.06 sht_hum=61.2 ds_temp=327.67
7 19/6/25 13:40 1 3012 sht_temp=28.09 sht_hum=74.2 ds_temp=327.67
8 19/6/25 13:45 1 3014 sht_temp=27.48 sht_hum=68.9 ds_temp=327.67
9 19/6/25 13:50 1 3016 sht_temp=28.30 sht_hum=80.6 ds_temp=327.67
10 19/6/25 14:06 1 3012 sht_temp=28.67 sht_hum=73.2 ds_temp=327.67
Start Tx and RTP events
OK
```

AT+CLRDTA: Clear the storage, record position back to 1st.

AT+RTP: Set record time period, default value 5 minute (AT+RTP=5). If RTP is set to 0, LHT65 will disable the record feature (RTP can be set by downlink command)

AT+DATE=19 05 30 16 21 58 set current time to 2019-5-30 16:21:58， AT+DATE=? to check the current time. System time error is ±2 min per month. This time can be configure via downlink command.

2.8 Alarm Mode

Alarm mode feature is added since firmware v1.5. When device is in Alarm mode, it will check the built-in sensor temperature in a short interval. If the temperature exceeds the pre-configure range, it will send an uplink immediately.

Note: Alarm mode will increase a little big the power consumption, we recommend extending the normal reading time when enable this feature.

AT Commands for Alarm mode:

AT+WMOD=1: Enable/Disable Alarm Mode. (0:Disable, 1: Enable)

AT+CITEMP=1: The interval to check temperature for Alarm. (Unit: minute)

2.9 LED Indicator

The LHT65 has a triple color LED which for easy showing different stage .

While user press ACT button, the LED will work as per LED status with ACT button.

In a normal working state:

- ✓ For each uplink, the BLUE LED or RED LED will blink once.
  - ✧ BLUE LED when external sensor is connected
  - ✧ RED LED when external sensor is not connected
- ✓ For each success downlink, the PURPLE LED will blink once

3. Use AT Command

3.1 Access AT Command

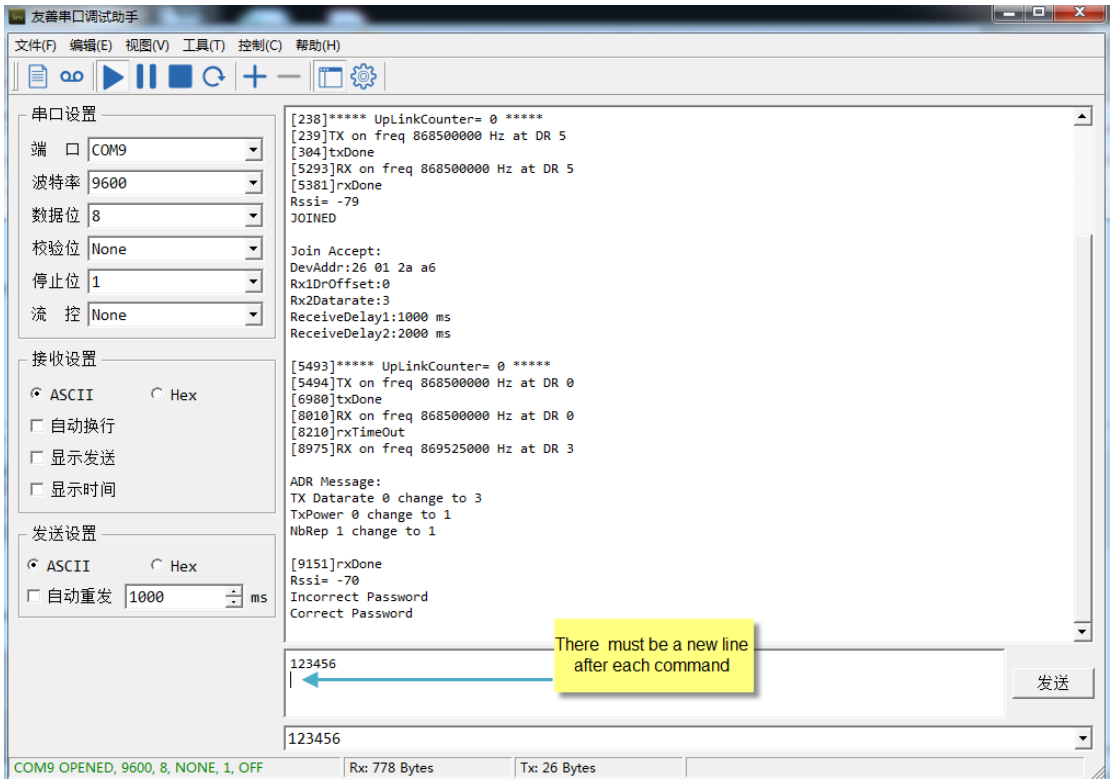
LHT65 supports AT Command set. User can use a USB to TTL adapter plus the Program Cable to connect to LHT65 for using AT command, as below.

Connection:

- ✓ USB to TTL GND <--> Dupont black pin
- ✓ USB to TTL RXD <--> Dupont green pin
- ✓ USB to TTL TXD <--> Dupont white pin

In PC, User needs to set **serial tool**(such as putty, SecureCRT) baud rate to **9600** to access to access serial console for LHT65. The AT commands are disable by default and need to enter password (default:**123456**) to active it. Timeout to input AT Command is 5 min, after 5 minute, user need to input password again. User can use AT+DISAT command to disable AT command before timeout.

Input password and ATZ to activate LHT65,As shown below:



Below are the available commands, a more detail AT Command manual can be found at AT Command Manual

AT+<CMD>? : Help on <CMD>

AT+<CMD> : Run <CMD>

AT+<CMD>=<value> : Set the value

AT+<CMD>=? : Get the value

ATZ: Trig a reset of the MCU

AT+FDR: Reset Parameters to Factory Default, Keys Reserve

AT+DEUI: Get or Set the Device EUI

AT+DADDR: Get or Set the Device Address

AT+APPKEY: Get or Set the Application Key

AT+NWKSKEY: Get or Set the Network Session Key

AT+APPSKEY: Get or Set the Application Session Key

AT+APPEUI: Get or Set the Application EUI

AT+ADR: Get or Set the Adaptive Data Rate setting. (0: off, 1: on)

AT+TXP: Get or Set the Transmit Power (0-5, MAX:0, MIN:5, according to LoRaWAN Spec)

AT+DR: Get or Set the Data Rate. (0-7 corresponding to DR_X)

AT+DCS: Get or Set the ETSI Duty Cycle setting - 0=disable, 1=enable - Only for testing

AT+PNM: Get or Set the public network mode. (0: off, 1: on)

AT+RX2FQ: Get or Set the Rx2 window frequency

AT+RX2DR: Get or Set the Rx2 window data rate (0-7 corresponding to DR_X)

AT+RX1DL: Get or Set the delay between the end of the Tx and the Rx Window 1 in ms

AT+RX2DL: Get or Set the delay between the end of the Tx and the Rx Window 2 in ms

AT+JN1DL: Get or Set the Join Accept Delay between the end of the Tx and the Join Rx Window 1 in ms

AT+JN2DL: Get or Set the Join Accept Delay between the end of the Tx and the Join Rx Window 2 in ms

AT+NJM: Get or Set the Network Join Mode. (0: ABP, 1: OTAA)

AT+NWKID: Get or Set the Network ID

AT+FCU: Get or Set the Frame Counter Uplink

AT+FCD: Get or Set the Frame Counter Downlink

AT+CLASS: Get or Set the Device Class

AT+JOIN: Join network

AT+NJS: Get the join status

AT+SENDB: Send hexadecimal data along with the application port

AT+SEND: Send text data along with the application port

AT+RECVB: Print last received data in binary format (with hexadecimal values)

AT+RECV: Print last received data in raw format

AT+VER: Get current image version and Frequency Band

AT+CFM: Get or Set the confirmation mode (0-1)

AT+CFS: Get confirmation status of the last AT+SEND (0-1)

AT+SNR: Get the SNR of the last received packet

AT+RSSI: Get the RSSI of the last received packet

AT+TDC: Get or set the application data transmission interval in ms

AT+PORT: Get or set the application port

AT+DISAT: Disable AT commands

AT+PWORD: Set password, max 9 digits

AT+CHS: Get or Set Frequency (Unit: Hz) for Single Channel Mode

AT+CHE: Get or Set eight channels mode,Only for US915,AU915,CN470

AT+DATE: Get or Set real time

AT+PDTA: Print the sector data from start page to stop page

AT+PLDTA: Print the last few sets of data

AT+CLRDTA: Clear the storage, record position back to 1st

AT+SLEEP: Set sleep mode

AT+EXT: Get or Set external sensor model

AT+RTP: Get or Set record time period in min

AT+CFG: Print all configurations

3.2 Common AT Command Sequence

3.2.1 Multi-channel ABP mode (Use with SX1301/LG308)

If device has not joined network yet:

123456

AT+FDR

123456

AT+NJM=0

ATZ

If device already joined network:

AT+NJM=0

ATZ

3.2.2 Single-channel ABP mode (Use with LG01/LG02)

Please refer this link: How to Set Single Channel Mode.

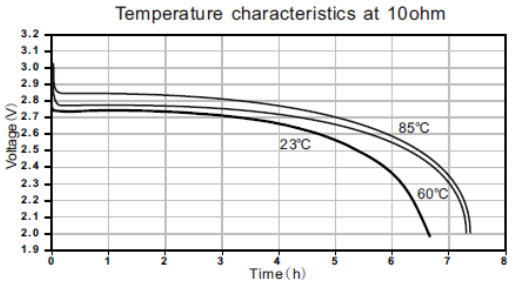
3.3 Battery Analyze

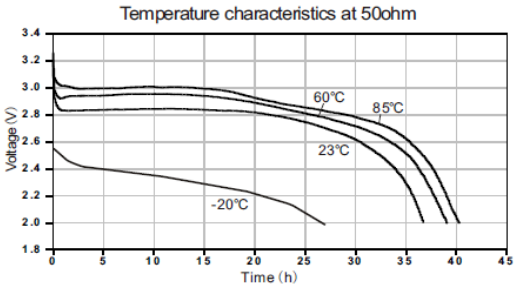
3.3.1 Battery Type

LHT-65 is equipped with a 2400mAH Li-MnO2 battery. The battery is un-rechargeable battery with low discharge rate targeting for 8~10 years use. This type of battery is commonly used in IoT target for long term running, such as water meter.

The discharge curve is not linear so can't simply use percentage to show the battery level. Below is the battery performance.

Performance





Minimum Working Voltage for the LHT65:

- ✓ LHT65: 2.45v ~ 3.6v
- ✓ ES-E1 Temperature Sensor : 2.35v ~ 5v

3.3.2 Power Consumption Analyze

Please refer the battery test report from below link:

http://www.dragino.com/downloads/index.php?dir=LHT65/Test_Report/

It includes the power consumption test base on EU868 and US915 on given transmit interval and working mode. It also includes the formula for how to calculate the power consumption. User can calculate the battery life base on a different uplink interval and network coverage on field to get a reference battery life.

4. Sensors & Accessories

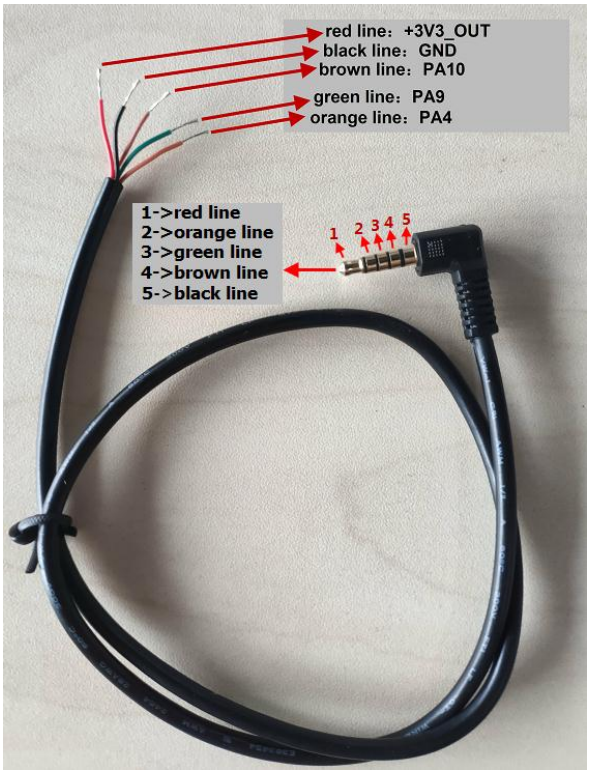
4.1 E1 Temperature Probe

With DS18B20 Temperature sensor with 1 meter cable long

- Resolution: 0.0625 °C
- ±0.5°C accuracy from -10°C to +85°C
- ±2°C accuracy from -55°C to +125°C
- Operating Range: -40 ~ 125 °C
- -55°C to 125°C
- Working voltage 2.35v ~ 5v

Pin order for E1 Temperature Sensor.

4.2 E2 Extension Cable



4.3 E3 Temperature Probe

With DS18B20 Temperature sensor with 2 meters cable long

- Resolution: 0.0625 °C
- ±0.5°C accuracy from -10°C to +85°C
- ±2°C accuracy from -55°C to +125°C
- Operating Range: -40 ~ 125 °C
- -55°C to 125°C
- Working voltage 2.35v ~ 5v

Note: Same payload format as E1 probe

4.4 E5 Illumination Pribe

BH1750 Illumination Sensor:

- Resolution: 1 lx
- Range: 0-65535 lx
- Operating Range: -40 °C ~ 85 °C

5. FAQ

5.1 How to upgrade the firmware?

The LHT65 is shipped with a program cable, which is used to upload image to LHT65 for:

- ✓ Support new features
- ✓ For bug fix
- ✓ Change LoRaWAN bands.

Video Instruction is here: https://youtu.be/0xpSWTCuDGQ

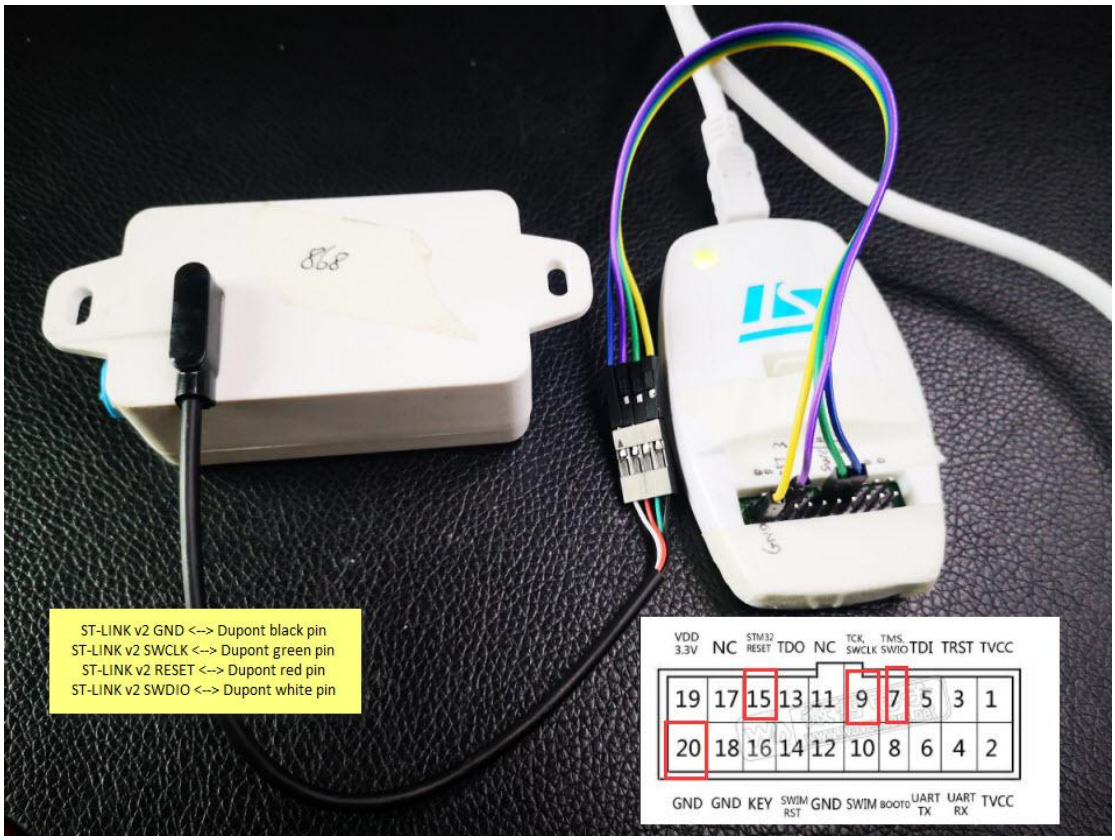
The latest firmware and changelog can be found at below link:
http://www.dragino.com/downloads/index.php?dir=LHT65/Firmware/

Below shows the hardware connection for how to upload an image to the LHT65:

Note:

1) There are different version ST-Link v2. The white one as below is the most stable and recommended one.

2) The white version ST-Link v2 such as below photo has different hardware version. The original one doesn't have 3.3v on pin 1/2 and the clone one has 3.3v on pin 1/2. User has to short pin19 (VDD 3.3v) and pin 1/2 (TVCC) for the original one so pin 1/2 has 3.3v power. Otherwise, the original one will have problem to upload firmware to LHT65.



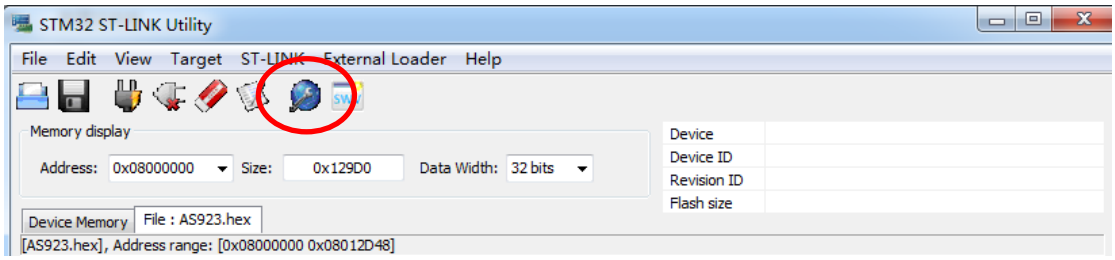
Connection:

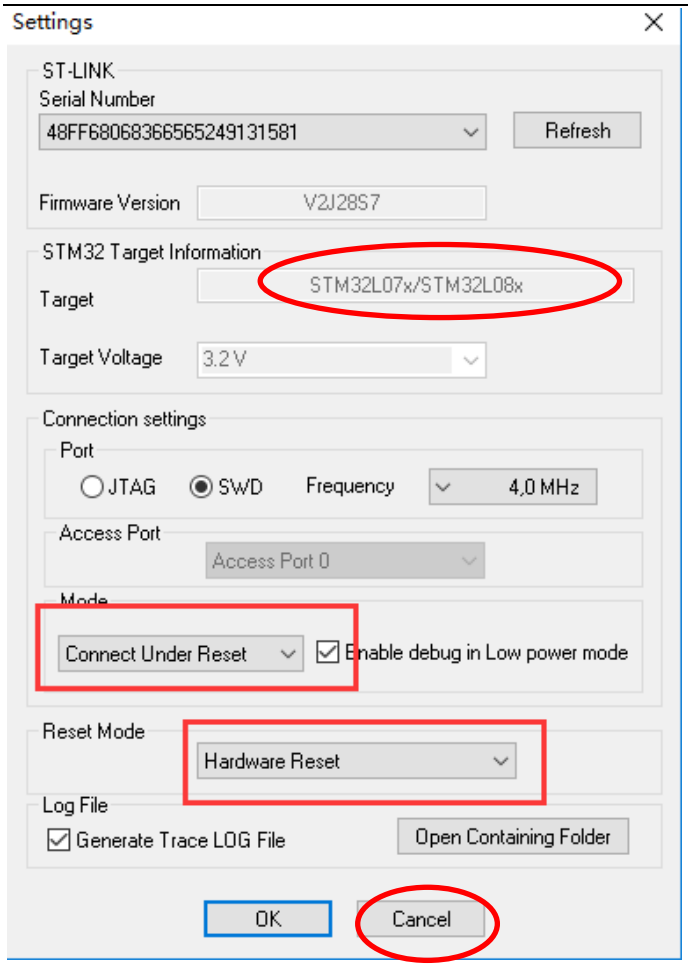
- ✓ ST-LINK v2 GND <--> Dupont black pin
- ✓ ST-LINK v2 SWCLK <--> Dupont green pin
- ✓ ST-LINK v2 RESET <--> Dupont red pin
- ✓ ST-LINK v2 SWDIO <--> Dupont white pin

Step1: Install ST-LINK driver first and then install ST-LINK Utility

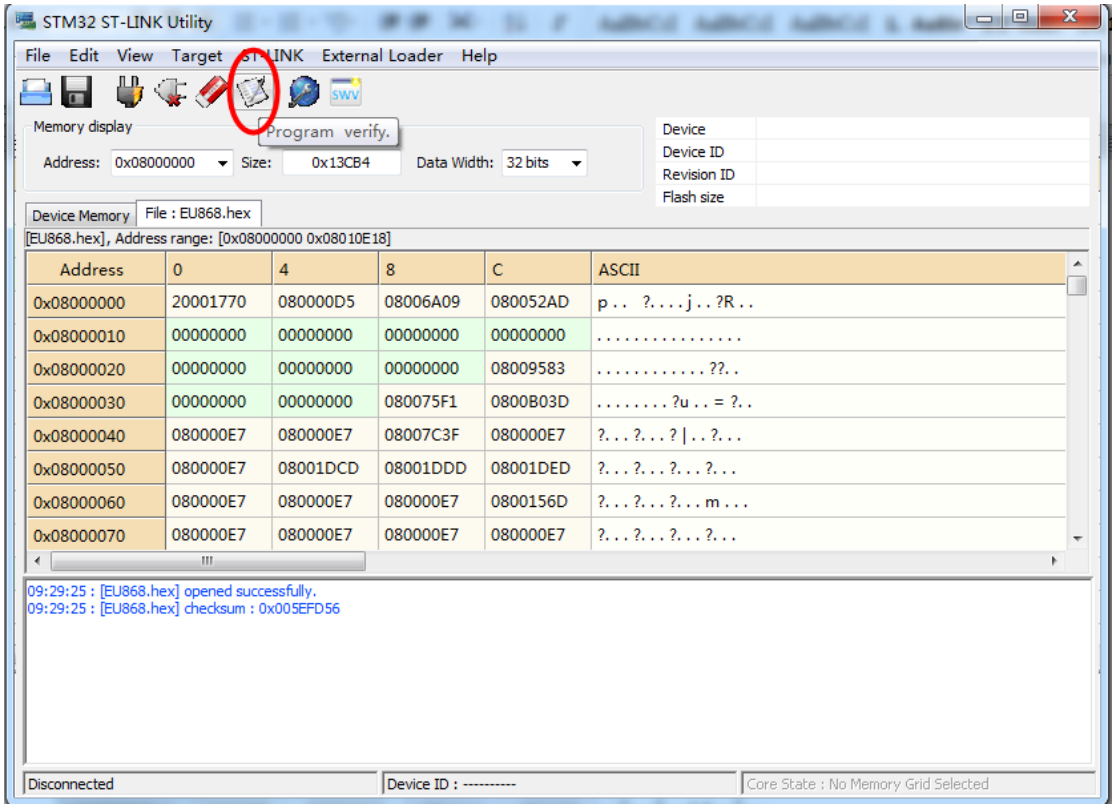
Step2: Download the LHT65 Image files.
http://www.dragino.com/downloads/index.php?dir=LHT65/Firmware/

Step3: click the blue global "**settings**" button on ST-LINK.
Make sure enable "Connect Under Reset" & "Hardware Reset".
ST-Link v2 should be able to see the STM32 chip as below.
Then Click **Cancel**.

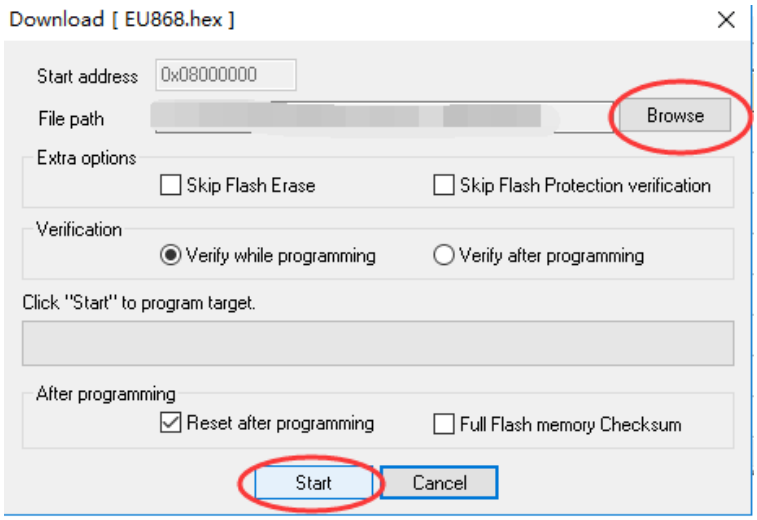



Settings
ST-LINK
Serial Number
48FF680683665652491315 81
Refresh
Firmware Version
V2J28S7
STM32 Target Information
Target
STM32L07x/STM32L08x
Target Voltage
3.2 V
Connection settings
Port
JTAG
SWD
Frequency
4,0 MHz
Access Port
Access Port 0
Mode
Connect Under Reset
Enable debug in Low power mode
Reset Mode
Hardware Reset
Log File
Generate Trace LOG File
Open Containing Folder
OK
Cancel

Step4: Click Program & Verify



Step5: The led on the ST-LINK adapter will now blinking, click program verify button to select the image to be upgraded.



Step5: Click the start button to download the image to LHT65.

*If you change different LoRa Frequency Bands/Region, you need using AT+FDR command to restore factory data after program success

5.2 How to change the LoRa Frequency Bands/Region?

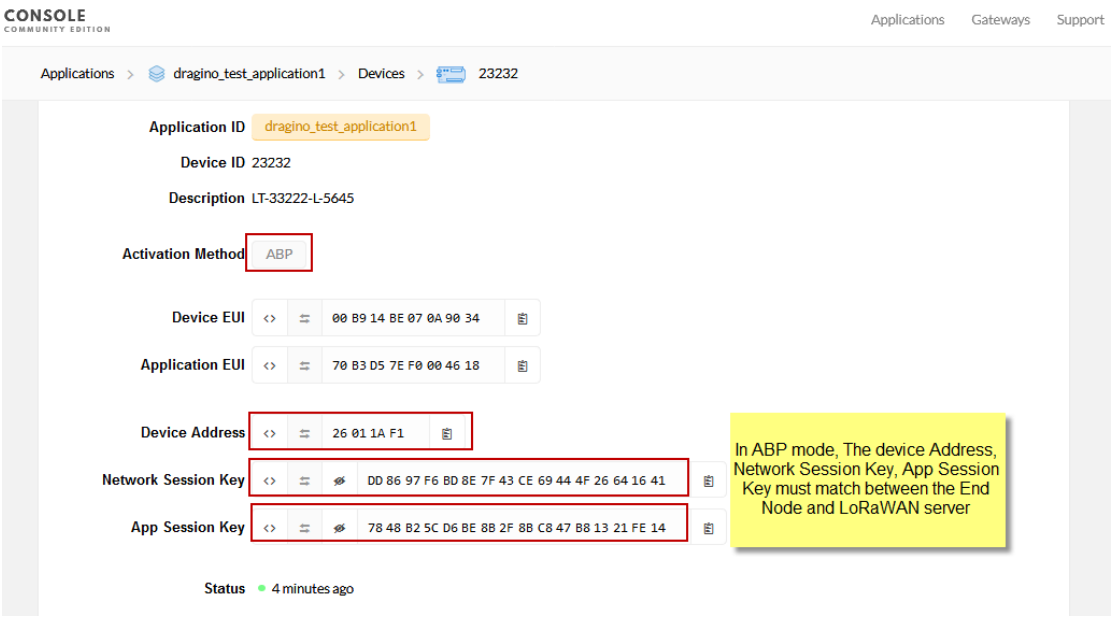
User can follow the introduction for how to upgrade image. When download the images, choose the required image file for download.

5.3 How to set up LHT65 to work with Single Channel Gateway such as LG01/LG02?

In this case, users need to set LHT65 to work in ABP mode & transmit in only one frequency. Assume we have a LG02 working in the frequency 868400000 now, below is the step.

Note: EU868 firmware can't set to Single Frequency, to use single frequency in EU, user can first upgrade the firmware to IN865 and set it to work in Single Frequency.

Step1: Log in TTN, Create an ABP device in the application and input the network session key (NETSKEY), app session key (APPSKEY) from the device.



Note: user just need to make sure above three keys match, User can change either in TTN or Device to make then match. In TTN, NETSKEY and APPSKEY can be configured by user in setting page, but Device Addr is generated by TTN.

Step2: Run AT Command to make LHT65 work in Single frequency & ABP mode. Below is the AT commands:

123456 Enter Password to have AT access.
AT+FDR Reset Parameters to Factory Default, Keys Reserve
123456 Enter Password to have AT access.
AT+NJM=0 Set to ABP mode
AT+ADR=0 Set the Adaptive Data Rate Off
AT+DR=5 Set Data Rate (Set AT+DR=3 for 915 band)
AT+TDC=60000 Set transmit interval to 60 seconds

AT+CHS=868400000 Set transmit frequency to 868.4Mhz

AT+DADDR=26 01 1A F1 Set Device Address to 26 01 1A F1

ATZ Reset MCU

5.4 How to reset LHT65?

The LHT65 has below pins in the back.

Use a metal wire to short NRST and GND pin will reset the LHT65.

5.5 What is the frequency plan of LHT65?

LHT65 use the same frequency as other Dragino products. User can see the detail from this link:
http://wiki.dragino.com/index.php?title=End_Device_Frequency_Band#Introduction

6. Trouble Shooting

6.1 AT Command input doesn't work

In the case if user can see the console output but can't type input to the device. Please check if you already include the <**ENTER>** while sending out the command. Some serial tool doesn't send <**ENTER>** after press the send key, user need to add <ENTER> in their string.

6.2 Why the temperature shows 327.67℃?

If the external sensor is 0x01, and there is no DS18B20 connected. The temperature will be set to 7FFF which is 327.67℃. In this case, please check the connection between the DS18B20 and the LHT65. User need to push the DS18B20 Audio jack hard to make the connection firmly. User will feel a click sound if connection is good.

6.3 Device no responses after Interrupt during upload or configure?

Possible the LHT65 are in program mode, try to short the NRST pin to GND to make it reset.

6.4 Have trouble to register to US915 or AU915 frequency band

Please see if related to the channel selection issue as shown here.

http://wiki.dragino.com/index.php?title=LoRaWAN_Communication_Debug#Notice_of_US915.2FCN470.2FAU915_Frequency_band

7. Order Info

Part Number: **LHT65-XX-YY**

XX: The default frequency band

- ✓ **AS923**: LoRaWAN AS923 band
- ✓ **AU915**: LoRaWAN AU915 band
- ✓ **EU433**: LoRaWAN EU433 band
- ✓ **EU868**: LoRaWAN EU868 band
- ✓ **KR920**: LoRaWAN KR920 band
- ✓ **US915**: LoRaWAN US915 band
- ✓ **IN865**: LoRaWAN IN865 band
- ✓ **CN470**: LoRaWAN CN470 band

YY:

- ✓ **00**: no external sensor
- ✓ **E1**: with model E1, temperature Probe (Default version)
- ✓ **E2**: with 3.5mm to 5 wire cable (For Interrupt, ADC, Counting)
- ✓ **E3**: Flat Temperature Probe (DS18B20)
- ✓ **E5**: with illumination Probe

External sensor can be ordered separately by using the sensor model + ES as prefix:

Part Number: **ES-YY**

Example: ES-E1

8. Packing Info

Package Includes:

- ✓ LHT65 Temperature & Humidity Sensor x 1
- ✓ Program cable x 1
- ✓ Optional external sensor

Dimension and weight:

- ✓ Device Size: cm
- ✓ Device Weight:
- ✓ Package Size / pcs : cm
- ✓ Weight / pcs :

9. Support

- Support is provided Monday to Friday, from 09:00 to 18:00 GMT+8. Due to different timezones we cannot offer live support. However, your questions will be answered as soon as possible in the before-mentioned schedule.
- Provide as much information as possible regarding your enquiry (product models, accurately describe your problem and steps to replicate it etc) and send a mail to

support@dragino.com

10. FCC Warning

This device complies with part 15 of the FCC Rules.Operation is subject to the following two conditions:

(1) This device may not cause harmful interference, and

(2) this device must accept any interference received,including interference that may cause undesired operation